APPENDIX 7-A

DATA QUALITY OBJECTIVES

Data quality objectives are qualitative and quantitative statements which specify the quality of data required to support decisions concerning the site. The type of decisions that may need to be made concerning a site include the priority ranking of the site, the extent of release investigation required, whether or not remedial action is necessary at the site, which remedial action is appropriate for the site, and whether or not the remedial action has been effective. Data quality objectives are determined based on the end uses of the data to be collected and should be specified for each data collection activity. The variability of site characteristics also makes it impossible to apply a generic set of data quality objectives to all situations. Investigators are expected to take advantage of previous experience and data collected for similar sites.

Data quality objectives are established prior to data collection. The data quality objective development process is integrated with the project planning process, and the results are incorporated into the site-specific sampling plan. The data quality objective development process results in a sampling plan that details the chosen sampling options and allows investigators to make statements concerning the confidence in the data obtained during the process. Confidence statements are possible through the application of statistical techniques to the data.

The following discussion summarizes the process by which data quality objectives are developed. Further details on the development process can be found in the U.S. EPA guidance documents titled:

1. *Data Quality Objectives for Remedial Response Activities - Development Process*, (EPA/540/G-87/003);

2. *Data Quality Objectives for Remedial Response Activities: Example Scenario: RI/FS Activities at a Site with Contaminated Soils and Groundwater,* (EPA/540/G-87/004);

3. *EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations*, (EPA QA/R-5, Interim Final, September, 1994);

4. *Guidance for the Data Quality Objective Process*, (EPA QA/G-4, Final, September 1994);

5. *Guidance for Quality Assurance Project Plans*, (EPA QA/G-5, February, 1998).

It should be noted that this discussion and the references cited above illustrate a process which is a product of EPA experience with very large scale and/or highly complex

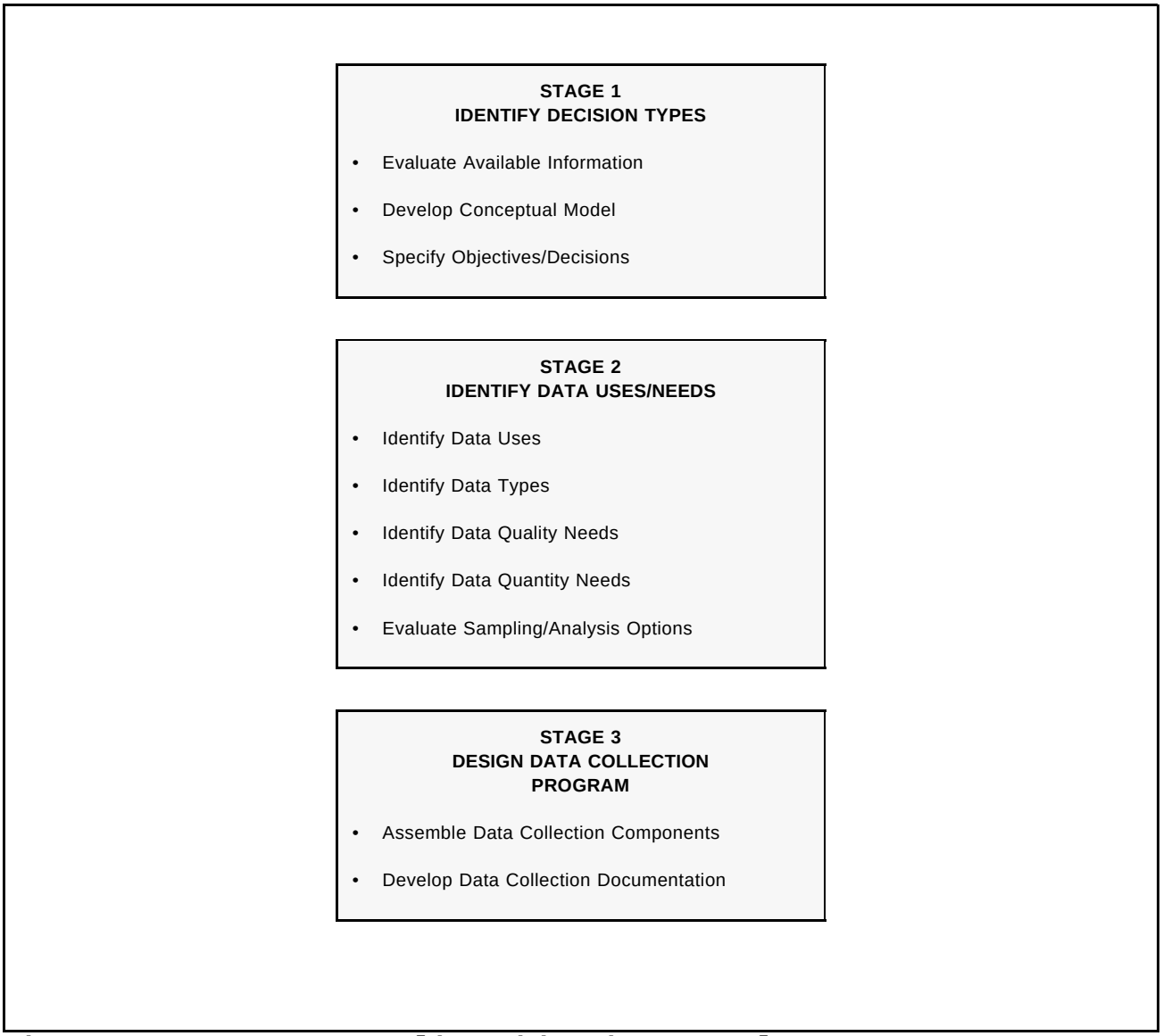

Figure 7A.1 Data Quality Objectives Development Process

investigations and corrective actions. By providing this information, the DOH UST Section does not imply that UST investigations or remeidal actions need be magnified to a similar scale or level of complexity. Rather, this information is intended to give a reasonably comprehensive discussion of data quality objectives, so that the reader develops an understanding of the process and its importance to conducting accurate, thorough investigations and remedial actions.

Data quality objectives are developed through a three-stage process, as illustrated in Figure 7A.1. Although the three stages are discussed sequentially, the development process is an iterative one, in which the data quality objectives are continually reviewed and re-evaluated based on the additional data collected.

STAGE 1 - IDENTIFY DECISION TYPES

Stage 1 of the data quality objective process defines the types of decisions which will be made regarding site prioritization, investigation, or remediation through a three-step process of evaluating existing data, developing a conceptual model, and specifying objectives for the project. Available information is compiled and analyzed for use in developing a conceptual model of the site, which describes suspected sources, contaminant pathways, and potential receptors. The model facilitates identification of decisions which must be made and deficiencies in the existing information.

EVALUATE AVAILABLE INFORMATION

Available information is reviewed and evaluated as the initial step in the data quality objectives process. The review of existing records and information obtained in initial site visits is used for a preliminary interpretation of site conditions. Any data obtained in previous site investigations should be analyzed to determine its usability. This evaluation determines the uncertainty associated with any conclusions drawn from the data. The following factors are related to the quality of the data and should be considered when evaluating the data.

- Age of the data
- Analytical methods used
- Detection limits of methods
- QA/QC procedures and documentation
- Sampling objectives and approach
- Sample collection methods
- Chain-of-custody documentation
- Sample preservation techniques
- Sample shipment methods
- Holding times

If limited or no information exists on sample collection, preservation techniques, or holding times, the data should be interpreted with caution or disregarded. If enough data are available, however, a detailed statistical evaluation could potentially be used to determine the confidence level of the data.

DEVELOP CONCEPTUAL MODEL

Conceptual models describe a site and its environs and present hypotheses regarding the contaminants present, their routes of migration, and their potential impact on sensitive receptors. The conceptual model should be detailed enough to address potential or suspected sources, types and concentrations of contaminants, affected media, and rates of migration. The hypotheses are refined as additional information on the site is obtained.

The following factors should be considered in developing the conceptual model:

- Human health and environmental concerns;
- Routes of exposure;
- Spatial distribution of contaminants;
- Atmospheric dispersion potential and proximity of receptors;
- Amount, concentration, hazardous properties, environmental fate, and form of substance(s) present;
- Hydrogeological factors;
- Climate;
- Extent to which natural or manmade barriers currently contain the substances and the adequacy of the barriers; and
- Assessment of the potential pathways of migration and extent of migration.

Additional data collected during the release investigation are used to expand the conceptual model and determine if sufficient data of adequate quality have been obtained to address the issues of concern.

SPECIFY OBJECTIVES/DECISIONS

Project objectives are developed to address the major issues concerning investigation and remediation of leaking UST's. These include characterizing the site with respect to the environmental setting, nature, and extent of the release; determining the proximity, size, and risk to human populations; identifying potential corrective actions; and determining the specific performance levels for the potential corrective actions.

Defining the types of decisions which will be made requires a clear understanding of the problems posed by the site and awareness of the consequences of making a wrong decision. The consequences of a wrong decision must be weighed for each major decision to be made. Where the consequences of a wrong decision carry significant public health, safety or environmental impacts, greater attention must be paid to obtaining the data required to ensure that the decision is sound. The value of obtaining additional data or increasing data quality is based on professional judgment. The intent of the data quality objective process is to provide a systematic approach for the evaluation of the risk associated with making a wrong decision.

STAGE 2 - IDENTIFY DATA USES/NEEDS

The conceptual model and the project objectives developed in Stage 1 become the basis for determining data uses and data needs in Stage 2. Stage 1 determines if existing data meet the project objectives. If the existing data are sufficient, there is no need to collect additional data. If the data are insufficient, the types, quality, and quantity of data which must be collected will be determined in Stage 2.

The major elements of Stage 2 of the data quality objectives process are:

- Identify data uses;
- Identify data types;
- Identify data quality needs;
- Identify data quantity needs; and
- Evaluate sampling/analysis options.

IDENTIFY DATA USES

Data uses can be described in general use categories. These categories represent generic uses; however, specific sites may require data for purposes other than those described here. The categories do not represent different data qualities, only different uses which may require data of a given quality. In other words, data collected for a site at a given level of quality may be used for different purposes. The data use categories are briefly described below:

- Site Characterization - Data are used to determine the nature and extent of contamination at an UST site. This category is usually the one that requires the most data collection. Site characterization data are generated through the sampling and analysis of waste sources and environmental media.

- Potentially Responsible Party (PRP) Determination - Data are used to determine the source of contamination at an UST site.

- Health and Safety - Data are typically used to establish the level of protection needed for investigators or workers at a site, and if there should be an immediate concern for the population living within the site vicinity.

- Risk Assessment - Data are used to evaluate the threat posed by an UST site to public health and the environment. Risk assessment data are generated through the sampling and analysis of environmental and biological media, particularly where the potential for human exposure is great.

- Evaluation of Corrective Action Alternatives - Data are used to evaluate various corrective action technologies.

- Engineering Design of Alternatives - Data collected during the release investigation can be used for engineering design purposes to evaluate the performance of various corrective action technologies. Data types which are applicable to this process include waste characterization and volume estimates.

- Monitoring During Corrective Action - During the corrective action, samples can be taken to assess the effectiveness of the action.

Once the data use categories are listed, the intended uses must be prioritized in order to identify the most demanding use of each type of data, i.e., the use requiring the highest level of confidence. The data quality required will be a function of the acceptable limits of uncertainty established by the decision-maker. The limits on uncertainty will drive the selection of both the analytical and sampling approaches.

IDENTIFY DATA TYPES

Data use categories define the general purposes for which data will be collected during the release investigation. Based on the intended uses, a concise statement regarding the data types needed is developed. Data types can be specified in broad groups initially, such as background samples or media (i.e., soil, water, or air) samples, and then these

broad groups are divided into more specific components, i.e., physical or chemical characteristics, organic or inorganic constituents, etc.

Figure 7A.2 illustrates the process of continual refinement of data types for a hypothetical groundwater contamination problem. The process should be followed for each media of interest. By identifying data types by media, overlapping data needs are identified. Thus, the types of analyses performed on each sample are determined by identifying data types. The data types specified in Stage 2 should not be limited to chemical analytical parameters, but should also include physical parameters such as permeability and porosity, which are needed to evaluate contaminant migration.

IDENTIFY DATA QUALITY NEEDS

Important factors in defining data quality include prioritizing data uses and determining appropriate analytical levels, contaminants of concern, levels of concern, required detection limits, and critical samples. These factors should be considered to define data quality needs in a general way at the start of the release investigation. As the work proceeds and more data become available, more precise statements can be made.

Data Quality Levels. The analytical levels are defined as follows:

- Data Quality Level 1 (DQL 1) - field screening or analysis using portable instruments. Results are often not compound specific or quantitative, but the results are available in real-time. It is the least costly of the analytical options. DQL 1 analyses that are applicable to UST sites include taking total vapor readings using photoionization detection or flame ionization detection meters that respond to a variety of volatile organic and inorganic compounds. Other DQL 1 analytical methods include detector tubes, colorimetric test kits, and fiber optic chemical sensors. Data generated from this type of analysis provide identification of locations that have a high likelihood of showing contamination through subsequent analysis and real-time data to be used for health and safety considerations during site characterization activities. Data produced from DQL 1 should only be considered as an indicator of contamination.

- Data Quality Level 2 (DQL 2) - field analyses using more sophisticated portable analytical instruments; in some cases, the instruments may be set up in a mobile laboratory onsite. There is a wide range in the quality of data that can be generated. It depends on the use of suitable calibration standards, reference materials, and sample preparation equipment; and the training of the operator. Results are available in real-time or in several hours. Typically DQL 2 methods provide reliable information for delineation of contaminants during a site assessment. DQL 2 analyses that are applicable to leaking UST sites include the use laboratory methods adapted for the field (e.g., portable GC methods).

- Data generated from DQL 2 are typically confirmed by submitting some duplicates to an off-site laboratory. Factors to consider in choosing the number (subset) of samples to be submitted for confirmational purposes include the

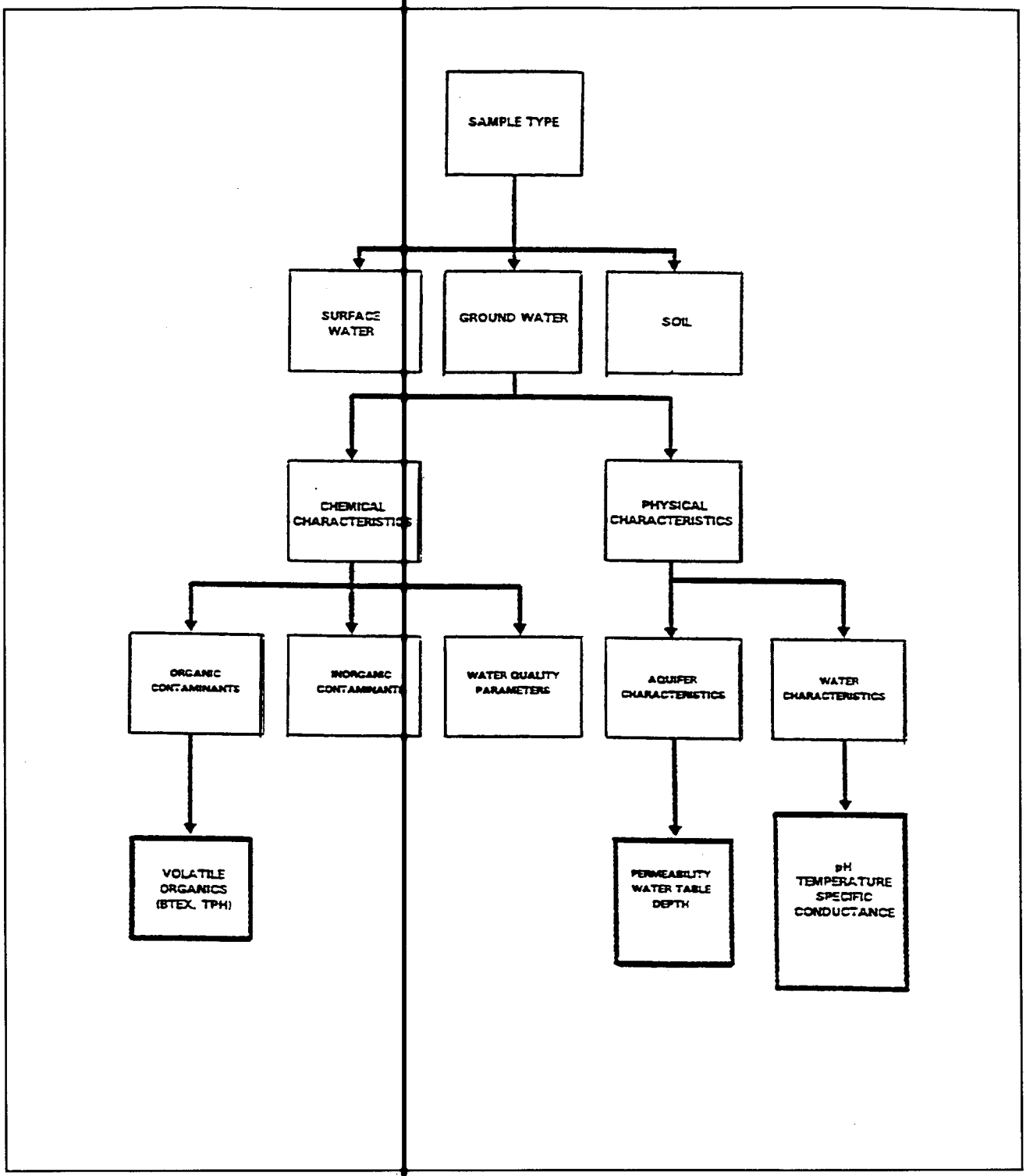

Figure 7A.2 Development of Data Types Logic Diagram

following: (1) total number of samples collected; (2) sampling objectives; (3) data uses; and (4) methods of analyses used. In general confirmational samples should include a subset (or all) of designated critical samples, a subset of samples covering the entire range of identified concentrations, a subset of samples near the appropriate DOH Tier 1 action level and near the not detectable range.

Data Quality Level 3 (DQL 3) - laboratory analysis which generates the most reliable data practicable and are approved laboratory methods (e.g., US. EPA SW-846 Laboratory Methods). DQL 3 data are highly reproducible and can provide the end user with full laboratory data deliverables and complete QA/QC documention. These methods can be used for confirming clean sample, regulatory monitoring and risk assessment. DQL 3 is usually performed off-site in a fixed laboratory or less commonly in an on-site mobile laboratory.

Table 7A.1 Summary of Analytical Levels Appropriate to Data Uses

Data Quality Level	Purpose of Sample	Example Methods or Instruments
1	Health & Safety during excavation, contaminant indicator and location	Portable PID (HNU), Portable FID (OVA), Detector Tubes, Colormetric Test Kits, Fiber Optic Chemical Sensors
2	Field use when excavating, contaminant delineation	Portable GC, Portable IR, Portable XRF, Portable AA, Immunoassay, USEPA SW-846 Field Screening Methods, Laboratory analyzed samples with limited QA/QC requirements, (i.e., USEPA SW-846 Laboratory Methods (3rd or most recent edition)
3	Confirmation sampling, regulatory monitoring, risk assessment	Laboratory analyzed samples with full QA/QC documentation, i.e., USEPA SW-846 Laboratory methods (3rd or most recent edition)

Table 7A.1 summarizes the type of analysis, data uses, limitations and data quality for the three analytical levels. It can be seen from Table 7A.1 that for each generic data use, several analytical levels may be appropriate. The decision-maker needs further criteria to select the most appropriate analytical level. Important criteria are the contaminants of concern and the

level of concern for each contaminant.

Contaminants of Concern. At some sites, it may be clear which contaminants are of concern because they have known adverse impacts on human health. In such cases, the appropriate health standards can be used to set levels of concern. Often at UST sites, there are numerous chemically related contaminants, so that it is not feasible or desirable to specify levels of concern for each observed or suspected contaminant. A small number of indicator chemicals are selected instead, and levels of concern are determined only for these chemicals. The indicator chemicals are the most toxic, mobile, persistent, or frequently occurring chemicals onsite.

Levels of Concern. The level of concern specifies a concentration value or range above which corrective action may need to be taken (i.e., cleanup levels). The DOH Tier 1 action levels, as shown in Table 5.2 define the level of concern. An exact action level is not required before initiating a release investigation; however, a rough estimate is necessary to ensure that the chosen analytical methods are accurate at the level of concern. Also, knowledge of the level of concern can influence the number of samples required and the selection of analytical methods. For these reasons, an acceptable range of values should be specified. As work on a site progresses and more data become available, the level of concern may be further refined and incorporated into the corrective action plan.

Detection Limit Requirements. The level of concern selected directly affects data quality requirements. The sampling and analysis methods used must be accurate at the level of concern. Since sampling accuracy is hard to evaluate or control, it is extremely important that the analytical technique chosen has a detection limit well below the level of concern. This factor must be considered in evaluating analytical options.

Critical Samples. Critical samples are those for which valid data must be obtained to satisfy the objectives of the sampling and analysis task. An example of a critical data point is an upgradient well in a ground-water contamination study or any other data point considered vital to the decision-making process. In some cases, taking critical samples in duplicate may be appropriate.

IDENTIFYING DATA QUANTITY NEEDS

In general, the greater the number of samples, the higher the degree of certainty in the data obtained. However, beyond a certain point, the cost of additional sampling is greater than the benefit gained by taking additional samples. Determining the number of samples to be taken at a site depends on the existing data for the site. In situations where data are unavailable or limited, a phased sampling approach is appropriate. A rationale is required for the selection of sample locations and number of samples. Factors to be considered in the absence of any analytical data that will assist in identifying additional data needs include:

- Do source materials still exist on the soil surface?

- Is there evidence of soil disturbance or vegetative stress based upon observation or review of photographs?

- Do geological features in the area control ground water and surface water flow patterns?

- Do site conditions favor surficial soil erosion or wind erosion?

- Are sensitive receptors located in the vicinity of the site?

The following EPA Guidance Manuals provide additional information: "Data Quality Objectives for Remedial Response Activities - Development Process," "RCRA Ground-Water Monitoring Technical Enforcement Guidance Document," "Preparation of Soil Sampling Protocol Techniques and Strategies," and "Soil Sampling Quality Assurance User's Guide."

EVALUATE SAMPLING/ANALYSIS OPTIONS

Developing a sampling and analysis approach, which ensures that appropriate levels of data quantity and quality are obtained, may be accomplished by use of a phased approach and by the use of field screening techniques to direct the data collection activities. By subdividing the data collection program into a number of phases, the data can be obtained in a sequence which allows it to be used to direct subsequent data collection activities. The time required for receipt of analytical data from laboratories often results in delays in a release investigation. By utilizing field techniques for assessing contaminant concentrations or media characteristics, the site investigation can proceed with fewer delays.

Large numbers of samples can be analyzed quickly and cost effectively in the field. Based on the results of the field monitoring, smaller numbers of samples can be further analyzed using more sophisticated procedures. The type and design of this analytical approach is determined by how the data will be used. By strategically selecting the samples analyzed at each level, a much higher degree of certainty can be obtained for the overall data set without sacrificing either the quantity of samples analyzed or the quality of data collected.

STAGE 3 - DESIGN DATA COLLECTION PROGRAM

Stage 3 of the data quality objective development process results in the specification of the methods by which data of acceptable quality and quantity will be obtained to make decisions. The first task in Stage 3 is to assemble all the information developed in the data quality objective process concerning the data types, quantities, and quality needed, and to prepare a schedule of sampling activities. The second task is to present the information developed on the data collection program in the site-specific sampling plans.